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(54) **A high-current cable for medium-frequency three-phase current**

(57) A high-current cable for medium-frequency three-phase current has six phase conductors 64 to 14 of the same cross-sectional area and shape symmetrically arranged around a cable core 2 and a null or protective conductor 20 surrounding the phase conductors. In a cable of this kind the loop impedance is significantly decreased relative to a cable having a null or protective conductor situated at the centre of the cable. Alternatively the phase conductors may be sector shape in cross-section (Figure 2 not shown) give to a further decrease in the loop impedance phase against phase and to decrease the external diameter of the cable for the same conductor cross-sectional area and, as a result of this, to increase in flexibility of the cable. The conductors 4 to 14 may be enamel-insulated conducting strands and the outer sheath 40 corrugated copper. The core 2 may be solid or stranded plastics. Diametrically opposed conductors are connected to the same phase.

Fig. 1

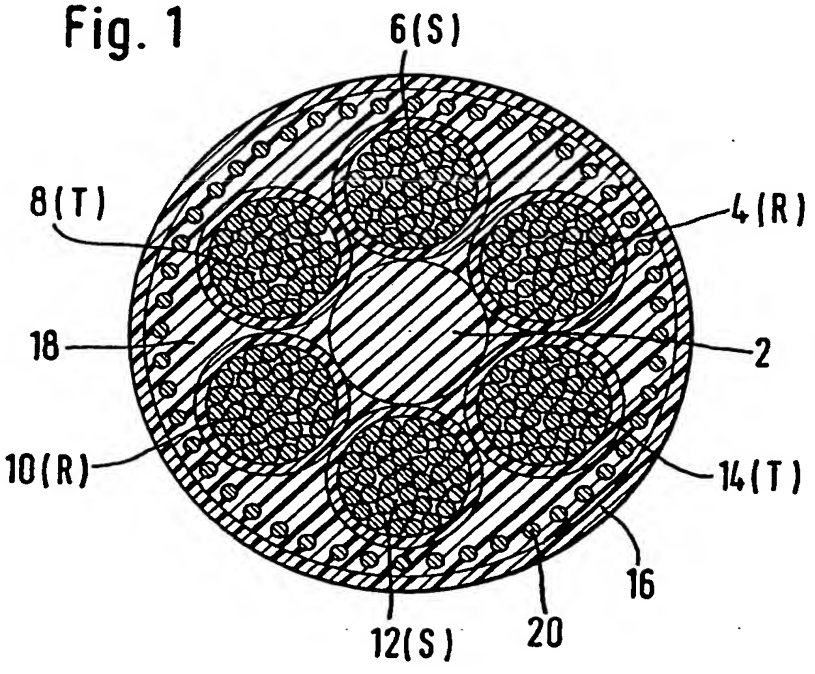

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Fig. 1

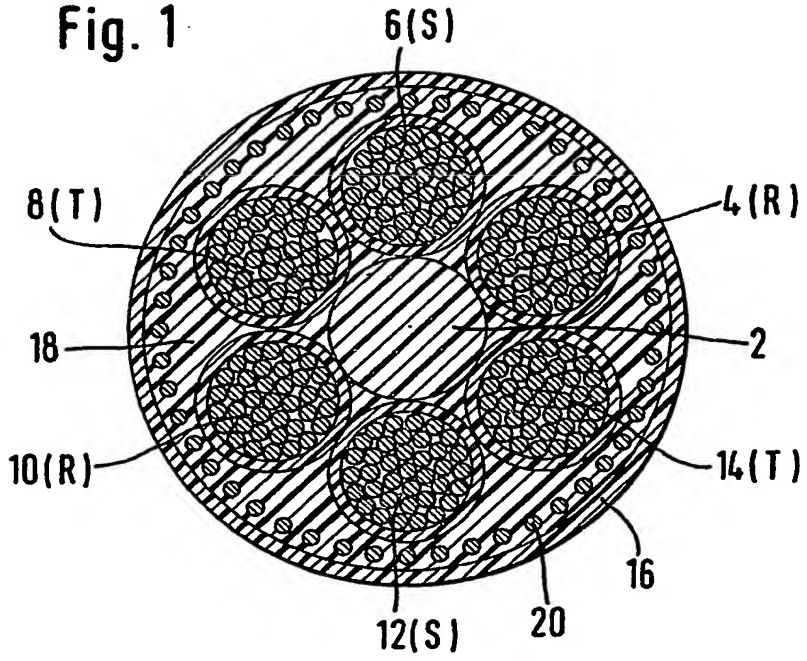
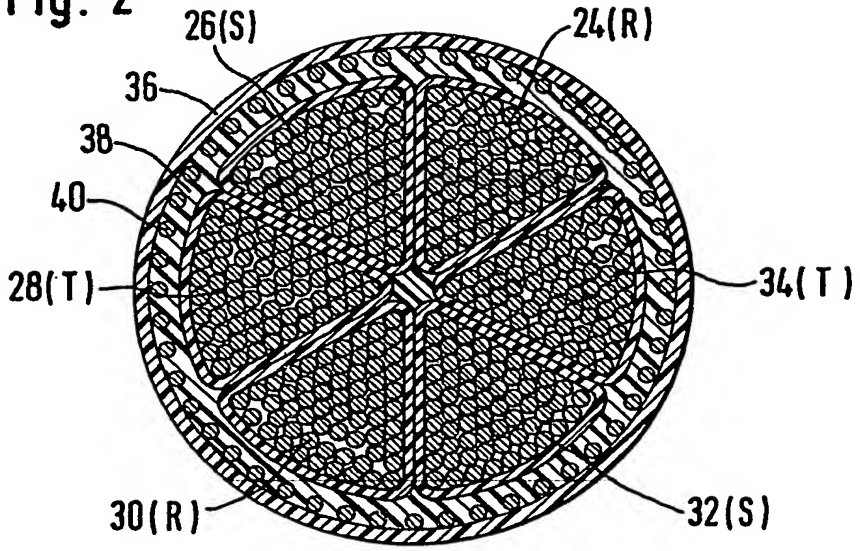


Fig. 2



SPECIFICATION

A high current mains for medium frequency three phase current and a high current cable for medium frequency three phase current.

The invention relates to a high current mains for medium frequency three phase current where a mains cable has six phase conductors of the same cross-sectional area and shape arranged symmetrically around the core of the cable, two of the said conductors, situated diametrically opposite each other, being for each phase connected together at the ends of the cable as the conductor for that phase and the mains cable having a null or protective conductor arranged symmetrically with respect to the phase conductors. The invention also relates to a high current cable for carrying medium frequency three phase current having six phase conductors of the same cross-sectional area and shape arranged symmetrically around the cable core and having a null or protective conductor situated symmetrically with respect to said phase conductors.

A known mains cable of the type referred to is described in our Patent Application No. 80300584 (Specification No. 2059670A) for medium frequency three phase current, in particular a mains supply having a frequency of 400 Hz or over. This known cable has a null or protective conductor arranged at the centre of the cable around which the six phase conductors are arranged symmetrically and, in particular, in a stranded arrangement. Mains cables of this type are characterised by low losses, high load capacity because of large surface area, low stray field, low inductance and a symmetrical construction.

It is an object of the invention, for high current cables of the type described in the opening paragraph hereof, to decrease further the losses and in particular to decrease the loop impedance, particularly the impedance between the phase and the null conductors.

This object is solved according to the invention by providing a cable in which the null or protective conductor surrounds the phase conductors as an external conductor concentric with the core. The loop impedance of such a cable between the phase conductors and the null or protective conductor is significantly reduced.

A further improvement with respect to a cable in accordance with the invention is that instead of the cable having phase conductors of circular cross-section, the cable has phase conductors which are substantially sector shape in cross-section. In a cable having sector-shaped phase conductors the loop impedance, phase against phase, is approximately 15% less than that obtained with the use of conductors of circular cross-section.

The cable having phase conductors has the additional advantage of a smaller diameter for the same predetermined copper cross-section. The cable is thus more flexible.

The design of the null or protective conductor as an external conductor has, in addition, the known tor makes contact with the exterior before contact with the phase conductors has occured. Three phase current cables having a null or protective conductor designed as an external conductor are, in themselves, known as NYCY-cables in which the three phase conductors are arranged at equal distances from one another. Such a cable is, however, not suitable for the transmission of medium frequency three phase current since, in this case, there is a very high decrease in reactive voltage and with large cross-sections very high transmission losses.

Cables in accordance with the invention are illustrated in the accompanying drawings in two embodiments and are described in more detail in the following with reference to the drawings. In the drawings,

Figure 1 is a cross-section through a cable having circular conductors, and

Figure 2 is cross-section through a cable having conductors in the form of sectors.

The cable illustrated in the Figure 1 has six phase conductors 4, 6 8, 10, 12 and 14 which are arranged symmetrically around the core of the cable. The cable core 2 has a circular profile and may, for example, be either formed from solid synthetic plastics material or from individual strands of synthetic plastics material.

The phase conductors 4, 6, 8, 10, 12 and 14 are constructed in the usual way from stranded individual wires. In the illustrated cable the individual wires are, preferably, separately insulated. Wires insulated with enamel are preferably used as the individual wires. The current displacement or skin effect is kept low by insulating the individual wires separately.

The complete phase conductors 4, 6, 8, 10, 12 and 14 are each surrounded by an insulating material and are designed as circular conductors. The phase conductors are embedded in an insulating mass 18. An external conductor 20, consisting of separate wires, is provided externally around the assembly of phase conductors 4, 6, 8, 10, 12 and 14 and is provided on its outer peripheral surface with a non-conducting coating or shield 16 which conveniently consists of synthetic plastics material and which gives protection against damp and mechanical damage. The external conductor 20 preferably consists of copper. It may be designed, in a known manner, as a corrugated copper casing.

Cables of this type described herein may have conductor cross-sections of up to 250 mm^2. In high current mains for medium frequency three phase current two diametrically-opposite phase conductors, thus conductors 4 and 10, 6 and 12 and 8 and 14 are, in each case, connected in parallel so that each of the phases R, S and T has two individual conductors arranged symmetrically diametrically-opposite one another. These conductors are in each case connected together at the ends of the cable.

In the cable shown in Figure 2 the six phase conductors 24, 26, 28, 30, 32 and 34 are each designed to have a cross-sectional shape in the form of a sector. In this way it is possible to reduce the external diameter of the six phase conductors for

that produced by the use of circular conductors. The individual conductors of sector form are provided with external insulation. Any remaining hollow spaces are filled with an insulating mass. At the least a layer 38 of an insulating mass is mounted externally around the conductors of sector form, on or in which the external casing 40 is arranged. In this case again the casing 40 consists of copper and is conveniently designed as a corrugated copper casing. The cable is provided externally with a non-conducting annular coating or shield 36 as a protection against moisture and mechanical damage.

In comparison with the cable shown in Figure 1, the cable shown in Figure 2 has the advantage of a smaller external cross-section for the same cross-sectional area of conductors and is thus more flexible so that it is easier to lay. In addition the cable having conductors of sector form has a very low impedance, phase against phase. The loop impedance is approximately 15% lower than in the embodiment shown in Figure 1. In the cable shown in Figure 2, when in use in high current mains, diametrically-opposite conductors which respectively represent the phases R, S and T are connected together at the cable ends, for each phase.

CLAIMS

1. A high current mains for medium frequency three phase current in which the mains cable has six phase conductors of the same cross-sectional area and shape and symmetrically arranged around the cable core, of which two diametrically-opposite conductors are, for each phase, connected together at the ends of the cable as the conductor for that phase and in which the mains cable has a null or protective conductor arranged symmetrically with respect to the phase conductors and surrounding the phase conductors as an external conductor concentric with the core.

2. A high current mains according to Claim 1, in which the phase conductors of the mains cable are in cross-section of substantially sector shape.

3. A high current cable for three phase current mains of medium frequency, having six phase conductors of the same cross-sectional area and shape and symmetrically arranged around a cable core and a null or protective conductor situated symmetrically with respect to said phase conductors and surrounding the phase conductors as an external conductor concentric with the core.

4. A cable according to Claim 3, in which the six phase conductors are in cross-section of substantially sector shape.

5. A cable according to Claim 3 or 4, in which each phase conductor is formed from a plurality of individual wires, each being covered by insulation.

6. A cable according to Claim 5, in which the individual wires are insulated by means of an enamel coating.

7. A cable according to any one of Claims 3-6 in which the null or protective conductor is a corrugated tubular casing.

8. A cable according to any one of Claims 3-7 in which the null or protective conductor is enclosed within an outer non-conducting coating or shield.

9. A high current cable for three phase current mains of medium frequency constructed and arranged substantially as described herein with reference to Figure 1 or 2 of the accompanying drawings.

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